



PHENOTYPIC VARIABILITY, CORRELATION AND PATH COEFFICIENT ANALYSIS IN POLE TYPE FRENCH BEANS (*PHASEOLUS VULGARIS* L.)

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Abstract

Correlation and path analysis studies on 18 marketable pod yield pod and yield attributing traits in 44 accessions of French bean revealed that marketable pod yield per plant had highly significant and positive association with length of inflorescence, number of inflorescence per plant, number of flowers per inflorescence, pod length, pod weight, number of pods per plant pod width and number of seeds per pod indicating the possibility of improvement in these traits through simultaneous selection. Path analysis for green pod yield per plant revealed that traits like number of pods per plant and pod weight exhibited high positive direct effects on green pod yield per plant. Number of pods per plant being chief contributing character for green pod yield with indirect effects through number of inflorescences per plant, number of seeds per pod, number of pods per inflorescence and length of inflorescence. Keeping in view the direct and indirect contribution of component traits towards total green pod yield per plant, the indirect selection on number of pods per plant number of inflorescences per plant, number of seeds per pod, number of pods per inflorescence and length of inflorescence in French bean is suggesting rewarding.

Key words : French bean, correlation and path coefficient analysis, yield characters.

Introduction

Common bean (*Phaseolus vulgaris* L.) is the most important and widely cultivated among all the beans. Dry edible beans; come in a wide variety of market classed, including kidney bean, navy bean, pinto bean, haricot bean, black bean, black bean, white bean and runner bean. These beans, although differing in the size and colouring of the seed are all just different types of a single species, *Phaseolus vulgaris* L. Its seed contain 19-31% protein, 2% fat, 61% carbohydrate (includes 5% fibres) as well as adequate levels of vitamins and minerals. It is grown for dried seeds, green pod vegetable and for processing as a frozen vegetable (Biswas *et al.*, 2010 and Singh, 2000). Yield of an economic part of a crop plant, a complex quantitative character is greatly dependent on several related characters. A study of correlation between different yield forming quantitative characters provides an idea of association that could be effectively exploited for selecting better plant types in crop improvement programmes. The estimation of correlation coefficients

indicates only the extent and nature of association between yield and its components, but does not show the direct and indirect effects of different yield attributes on yield per se. Pod yield is dependent on several characters which are mutually associated; these will in turn impair the true association existing between a component and pod yield. A change in any one component is likely to disturb the whole network of cause and effect. Thus, each component has two paths of action viz., the direct influence on pod yield and the indirect effect, through components which are not revealed from the correlation studies. Keeping in view, the importance of these biometrical approaches, an experiment was conducted to know the direct and indirect effects of yield and its attributing characters in common bean.

Materials and Methods

Forty one genotypes along with three checks viz., Kentucky wonder, PLB-10-01 and Ayoka were evaluated in randomized block design with three replications during 2011-12 at Vegetable Research Station, A.R.I.,

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Table 1 : Qualitative traits in forty four genotypes of French bean.

Character-Geno- types	Stem pigmentation	Flower wing colour	Pod shape	Pod colour	Pod beak shape	Pod curvature	Parchment layer	Pod pubescence	Seed colour	Seed mottling	Brilliance of seed	Seed shape
SRS-13429	Green	DPP	Flat	BP	long	Straight	Present	Dense	Cream	Present	Matt	Oval
SRS-13430	Green	White	Flat	Green	Short	SC	Present	Sparse	White	Absent	Shiny	Kidney
SRS-13443	Green	White	Flat	DG	Medium	Straight	Present	Sparse	Cream	Present	Matt	Oval
SRS-13444	Green	White	Flat	IG	Medium	SC	Present	Intermediate	White	Absent	Shiny	Kidney
SRS-13449	Purple	White	Flat	Green	Medium	Straight	Present	Sparse	White	Absent	Shiny	Kidney
SRS-13451	Purple	White	Flat	DG	Short	SC	Present	Intermediate	Red	Absent	Intermediate	Kidney
SRS-13454	Green	White	Flat	IG	Short	Straight	Present	Intermediate	White	Absent	Shiny	Kidney
SRS-13456	Green	White	Flat	IG	Long	SC	Present	Sparse	Brown	Present	Matt	Kidney
SRS-13459	Purple	White	Flat	Green	Short	Straight	Present	Intermediate	Maroon	Absent	Shiny	Kidney
SRS-13460	Green	White	Flat	DG	Short	SC	Present	Dense	White	Absent	Shiny	Square
SRS-13461	Green	White	Flat	DG	Medium	Straight	Present	Sparse	White	Absent	Shiny	Kidney
SRS-13462	Green	Violet	Flat	BP	Medium	Straight	Absent	Intermediate	Cream	Present	Intermediate	Oval
SRS-13463	Green	White	Flat	Green	Short	SC	Present	Intermediate	White	Absent	Shiny	Kidney
SRS-13470	Green	LP	Flat	DG	Medium	Straight	Present	Intermediate	Cream	Present	Matt	Oval
SRS-13471	Green	White	Flat	Green	Medium	Straight	Present	Sparse	White	Absent	Shiny	Kidney
SRS-13480	Green	LP	Flat	Green	Short	SC	Present	Intermediate	Maroon	Absent	Shiny	Rectangular
SRS-13481	Green	LP	Flat	DG	Long	Straight	Present	Sparse	Cream	Present	Intermediate	Kidney
SRS-13482	Purple	Violet	Round	DG	Short	SC	Present	Sparse	Brown	Present	Shiny	Kidney
SRS-13483	Green	LP	Flat	IG	Long	Straight	Present	No hairs	Brown	Absent	Shiny	Kidney
SRS-13491	Green	White	Flat	DG	Short	Straight	Present	Sparse	CY	Absent	Shiny	Round
SRS-13494	Green	White	Flat	DG	Medium	SC	Present	Intermediate	Yellow	Absent	Shiny	Oval
SRS-13496	Green	Violet	Flat	BP	Medium	SC	Present	Sparse	Cream	Present	Intermediate	Oval
SRS-13497	Green	LP	Flat	Green	Short	Straight	Present	Intermediate	Cream	Absent	Shiny	Round
SRS-13498	Green	Violet	Flat	BP	Long	SC	Present	Dense	Brown	Present	Matt	Kidney
SRS-13499	Green	Violet	Flat	DG	Medium	Straight	Present	Intermediate	Cream	Present	Mattt	Rectangular
SRS-13500	Green	White	Flat	BP	Medium	SC	Present	Intermediate	Maroon	Present	Intermediate	Oval
SRS-13504	Green	White	Flat	IG	Medium	Curved	Present	Dense	Cream	Present	Matt	Oval
SRS-13505	Green	White	Flat	Green	Short	Curved	Present	Sparse	Yellow	Absent	Shiny	Oval
SRS-13522	Green	LP	Flat	Green	Medium	Straight	Absent	Dense	Yellow	Absent	Shiny	Oval
SRS-13525	Green	DPP	Flat	BP	Short	SC	Present	Intermediate	Cream	Present	Matt	Oval
SRS-13526	Green	Violet	Flat	BP	Short	SC	Present	Intermediate	Maroon	Present	Matt	Oval

Table 1 continued..

Table 1 continued...

	Green	LP	Flat	DG	Long	SC	Present	Dense	Maroon	Present	Shiny	Round
SRS-13527	Green	LP	Flat	DG	Long	SC	Present	Dense	Maroon	Present	Shiny	Round
SRS-13530	Green	DPP	Flat	BP	Medium	SC	Present	Dense	Cream	Present	Intermediate	Oval
SRS-13536	Green	LP	Flat	Green	Medium	Straight	Present	Dense	Yellow	Absent	Shiny	Oval
SRS-13546	Green	LP	Flat	IG	Medium	SC	Present	Dense	Maroon	Absent	Shiny	Oval
SRS-13547	Green	White	Flat	Green	Medium	Curved	Present	Dense	Red	Absent	Shiny	Kidney
SRS-13552	Purple	Violet	Round	DG	Short	SC	Absent	Intermediate	Cream	Present	Shiny	Kidney
AUV-315	Green	LP	Flat	IG	Short	SC	Present	Dense	Maroon	Absent	Shiny	Oval
AUV-317	Green	White	Flat	DG	Short	SC	Present	Sparse	Red	Absent	Shiny	Oval
PMA-01-237	Green	LP	Flat	Green	Short	SC	Present	Intermediate	Red	Absent	Shiny	Kidney
RSM-842	Green	White	Flat	DG	Short	Straight	Present	Intermediate	Red	Absent	Shiny	Kidney
Kentucky Wonder	Green	White	Round	IG	Short	Curved	Absent	Sparse	Brown	Absent	Intermediate	Kidney
PLB-10-01	Green	LP	Flat	DG	Medium	SC	Present	Intermediate	Maroon	Absent	Shiny	Rectangular
Ayoka	Purple	DPP	Round	DG	Short	SC	Present	Sparse	Black	Absent	Shiny	Kidney

LG - light green, DG - dark green, BP - black pigmented all over, DPP - deep pink to purple, LP - light pink, CY - creamish yellow, SC - slightly curved.

Table 2 : Direct and indirect effects of various yield and yield attributes on pod yield in forty four genotypes of French bean.

Character	Plant height (cm)	No. of primary branches per plant	Days to first flowering	Days to 50 per cent flowering	Length of inflorescence (cm)	No. of inflorescences per plant	No. of flowers per inflorescence	No. of pods per inflorescence	Days to first pod harvest	Days to last pod harvest	Pod length (cm)	Pod width (cm)	Pod weight (g)	No. of pods per plant	No. of seeds per pod	100 seed weight (g)	Protein content (%)	Correlation coefficient
1	P	-0.0023	0.0003	-0.0005	-0.0001	-0.0005	0.0001	-0.0003	-0.0003	-0.0005	0.0000	0.0009	0.0006	-0.0002	-0.0005	0.0006	0.0002	-0.0855
	G	0.0465	-0.0072	0.0119	0.0108	0.0017	0.0115	-0.0018	0.0073	0.0070	-0.0013	-0.0212	-0.0121	0.0033	0.0129	-0.0135	-0.0050	-0.0941
2	P	-0.0019	0.0138	-0.0013	-0.0017	0.0012	0.0019	-0.0043	-0.0019	-0.0026	-0.0010	-0.0016	-0.0018	0.0017	-0.0002	0.0002	0.0005	0.0539
	G	-0.0144	0.0934	-0.0116	-0.0118	0.0101	0.0121	0.0315	-0.0411	-0.0117	-0.0075	-0.0130	-0.0147	0.0114	0.0000	0.0010	0.0047	0.0426
3	P	-0.0011	0.0004	-0.0047	-0.0043	0.0006	0.0001	0.0006	-0.0009	-0.0040	-0.0011	0.0008	-0.0007	0.0005	-0.0004	0.0017	0.0012	0.0621
	G	-0.0365	0.0177	-0.1425	-0.1371	0.0186	0.0040	0.0196	-0.0316	-0.1309	-0.0349	0.0258	-0.0233	0.0146	-0.0129	0.0522	0.0372	0.0680
4	P	0.0282	-0.0162	0.1183	0.1284	-0.0152	-0.0086	0.0154	0.0270	0.1088	0.0247	-0.0256	0.0143	-0.0166	0.0182	-0.0416	-0.0287	0.0107
	G	0.1164	-0.0637	0.4840	0.5031	-0.0572	-0.0325	-0.0730	0.1259	0.4573	0.0790	0.1066	-0.1050	0.0564	-0.0711	-0.1674	-0.1146	0.0076
5	P	-0.0013	-0.0035	0.0050	0.0049	-0.0411	-0.0143	-0.0220	-0.0184	0.0080	-0.0034	0.0094	0.0001	-0.0146	-0.0012	0.0041	0.0024	0.3492
	G	-0.0026	-0.0080	0.0097	0.0084	-0.0742	-0.0274	-0.0425	-0.0374	0.0164	0.0347	-0.0063	0.0198	-0.0003	-0.0281	0.0078	0.0042	0.3753

Table 2 continued...

Table 2 continued...

6	P	0.0149	0.0088	-0.0016	-0.0042	0.0217	0.0625	0.0116	0.0242	-0.0090	-0.0024	0.0045	-0.0193	-0.0081	0.0492	0.0305	-0.0172	0.0080	0.6221
	G	-0.0145	-0.0076	0.0016	0.0038	-0.0216	-0.0584	-0.0120	-0.0257	0.0089	0.0018	-0.0039	0.0206	0.0076	-0.0480	-0.0311	0.0168	-0.0080	0.6578
7	P	-0.0017	0.0161	-0.0065	-0.0065	0.0290	0.0101	0.0543	0.0140	-0.0094	-0.0161	0.0107	-0.0084	-0.0003	0.0164	0.0071	0.0003	-0.0022	0.3346
	G	-0.0012	0.0102	-0.0042	-0.0044	0.0174	0.0062	0.0303	0.0072	-0.0061	-0.0095	0.0072	-0.0061	0.0003	0.0102	0.0051	0.0001	-0.0016	0.3882
8	P	0.0057	-0.0136	0.0086	0.0091	0.0194	0.0168	0.0112	0.0434	0.0024	-0.0112	0.0069	-0.0092	0.0051	0.0159	0.0160	-0.0124	0.0047	0.4405
	G	0.0198	-0.0554	0.0279	0.0315	0.0634	0.0554	0.0301	0.1259	0.0119	-0.0368	0.0263	-0.0285	0.0169	0.0515	0.0564	-0.0396	0.0148	0.5110
9	P	-0.0137	0.0128	-0.0808	-0.0797	0.0183	0.0135	0.0164	-0.0052	-0.0941	-0.0259	0.0013	0.0050	0.0019	0.0201	0.0131	0.0316	0.0225	-0.1730
	G	-0.0560	0.0469	-0.3434	-0.3399	0.0824	0.0570	0.0747	-0.0353	-0.3740	-0.1091	0.0039	0.0217	0.0044	0.0790	0.0559	0.1296	0.0964	-0.1689
10	P	-0.0171	0.0134	-0.0102	-0.0102	0.0302	0.0027	0.0209	0.0182	-0.0194	-0.0704	0.0143	0.0009	0.0111	0.0093	0.0086	0.0012	0.0092	-0.2820
	G	-0.0053	0.0041	-0.0032	-0.0032	0.0096	0.0006	0.0065	0.0060	-0.0060	-0.0206	0.0044	0.0003	0.0034	0.0027	0.0023	0.0003	0.0026	-0.2978
11	P	-0.0002	-0.0024	0.0082	0.0066	0.0028	0.0025	0.0068	0.0055	-0.0005	-0.0070	0.0343	0.0020	0.0208	-0.0011	0.0072	0.0034	-0.0025	0.4159
	G	-0.0003	-0.0009	0.0026	0.0023	0.0009	0.0007	0.0025	0.0022	-0.0001	-0.0023	0.0107	0.0001	0.0069	-0.0004	0.0027	0.0011	-0.0010	0.4574
12	P	0.0008	0.0002	0.0003	0.0004	0.0005	0.0007	0.0003	0.0005	0.0001	0.0000	-0.0001	-0.0021	-0.0008	0.0009	0.0012	-0.0009	-0.0001	-0.1202
	G	0.0079	0.0024	0.0031	0.0036	0.0046	0.0061	0.0035	0.0039	0.0010	0.0002	-0.0002	-0.0173	-0.0074	0.0077	0.0113	-0.0076	-0.0010	-0.1226
13	P	-0.1465	-0.0781	0.0944	0.0671	-0.0007	-0.0782	-0.0035	0.0705	-0.0118	-0.0947	0.3650	0.2391	0.6017	-0.1739	0.0255	0.1253	0.0307	0.3863
	G	-0.1816	-0.1097	0.1140	0.0781	0.0027	-0.0910	0.0062	0.0936	-0.0083	-0.1146	0.4507	0.3001	0.6972	-0.2140	0.0255	0.1484	0.0303	0.3918
14	P	0.0594	0.1041	-0.0863	-0.1105	0.3021	0.6717	0.2576	0.3119	-0.1825	-0.1123	-0.0274	-0.3555	-0.2466	0.8534	0.4291	-0.1884	-0.0123	0.7156
	G	0.0734	0.1266	-0.1065	-0.1468	0.3933	0.8536	0.3499	0.4247	-0.2195	-0.1361	-0.0397	-0.4616	-0.3189	1.0388	0.5922	-0.2461	-0.0075	0.7219
15	P	-0.0215	0.0016	-0.0089	-0.0136	-0.0262	-0.0469	-0.0125	-0.0355	0.0134	0.0118	-0.0201	0.0520	-0.0041	-0.0482	-0.0959	0.0277	-0.0049	0.4446
	G	-0.0720	0.0001	-0.0235	-0.0331	-0.0881	-0.1376	-0.0433	-0.1160	0.0387	0.0284	-0.0642	0.1692	-0.0095	-0.1476	-0.2590	0.0836	-0.0184	0.5072
16	P	0.0017	-0.0001	0.0021	0.0019	0.0006	0.0016	0.0000	0.0017	0.0020	0.0001	-0.0006	-0.0024	-0.0012	0.0013	0.0017	-0.0059	0.0012	-0.0492
	G	0.0137	-0.0005	0.0173	0.0157	0.0049	0.0136	-0.0002	0.0149	0.0163	0.0007	-0.0049	-0.0209	-0.0100	0.0112	0.0152	-0.0472	0.0097	-0.0565
17	P	0.0110	-0.0037	0.0260	0.0236	0.0062	-0.0135	0.0042	-0.0115	0.0252	0.0138	0.0077	-0.0060	-0.0054	0.0015	-0.0054	0.0209	-0.1057	-0.0759
	G	0.0126	-0.0059	0.0307	0.0267	0.0067	-0.0161	0.0063	-0.0137	0.0302	0.0149	0.0105	-0.0065	-0.0051	0.0008	-0.0083	0.0240	-0.1173	-0.0745

Phenotypic Residual Effect = 0.2769, Genotypic Residual Effect = 0.1300, Diagonal (bold) values indicate direct effect and values below and above diagonal indicate indirect effects.

Table 3 : Phenotypic (P) and genotypic (G) correlation coefficients for eighteen yield and yield attributing traits in forty four genotypes of French bean.

Character	Plant height (cm)	Number of primary branches per plant	Days to first flowering	Days to 50 per cent flowering	Length of inflorescence (cm)	No. of inflorescence per plant	No. of flowers per inflorescence	No. of pods per inflorescence	Days to first pod harvest	Days to last pod harvest	Pod length (cm)	Pod width (cm)	Pod weight (g)	No. of pods per plant	No. of seeds per pod	100 seed weight (g)	Protein content (%)	Marketable yield per plant (g)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	P 1.000	-0.1357	0.2395	0.2199	0.0326	0.2384	-0.0308	0.1311	0.1458	0.2429	-0.0052	-0.3968	-0.2435	0.0697	0.2244	-0.2775	-0.1045	-0.0855
	G 1.0000	-0.1538	0.2563	0.2314	0.0357	0.2479	-0.0383	0.1574	0.1496	0.2553	-0.0276	-0.4555	-0.2805	0.0706	0.2781	-0.2896	-0.1072	-0.0941
2	P -0.1357	1.0000	-0.0924	-0.1259	0.0848	0.1404	0.2957	-0.3136	-0.1355	-0.1900	-0.0708	-0.1151	-0.1297	0.1220	-0.0164	0.0166	0.0352	0.0539
	G -0.1538	1.0000	-0.1241	-0.1266	0.1080	0.1293	0.3368	-0.4399	-0.1255	-0.2000	-0.0801	-0.1396	-0.1574	0.1218	-0.0004	0.0106	0.0505	0.0426
3	P 0.2395	-0.0924	1.0000	0.9209	-0.1221	-0.0254	-0.1196	0.1978	0.8582	0.1442	0.2378	-0.1603	0.1569	-0.1012	0.0928	-0.3573	-0.2458	0.0621
	G 0.2563	-0.1241	1.0000	0.9620	-0.1307	-0.0282	-0.1375	0.2217	0.9183	0.1533	0.2451	-0.1807	0.1635	-0.1025	0.0906	-0.3666	-0.2613	0.0680
4	P 0.2199	-0.1259	0.9209	1.0000	-0.1182	-0.0667	-0.1198	0.2099	0.8469	0.1450	0.1925	-0.1995	0.1114	-0.1295	0.1421	-0.3237	-0.2233	0.0107
	G 0.2314	-0.1266	0.9620	1.0000	-0.1136	-0.0645	0.1451	0.2503	0.9089	0.1569	0.2118	-0.2086	0.1120	-0.1413	0.1279	-0.3327	-0.2277	0.0076
5	P 0.0326	0.0848	-0.1221	-0.1182	1.0000	0.3475	0.5345	0.4477	-0.1943	-0.4285	0.0824	-0.2292	-0.0012	0.3539	0.2728	-0.1002	-0.0583	0.3492
	G 0.0357	0.1080	-0.1307	-0.1136	1.0000	0.3691	0.5722	0.5037	-0.2204	-0.4679	0.0849	-0.2663	0.0039	0.3786	0.3402	-0.1044	-0.0571	0.3753
6	P 0.2384	0.1404	-0.0254	-0.0667	0.3475	1.0000	0.1859	0.3875	-0.1432	-0.0386	0.0727	-0.3096	-0.1300	0.7870	0.4886	-0.2753	0.1275	0.6221
	G 0.2479	0.1293	-0.0282	-0.0645	0.3691	1.0000	0.2051	0.4400	-0.1524	-0.0310	0.0663	-0.3519	-0.1304	0.8217	0.5315	-0.2878	0.1376	0.6578
7	P -0.0308	0.2957	-0.1196	-0.1198	0.5345	0.1859	1.0000	0.2571	-0.1739	-0.2973	0.1978	-0.1550	-0.0058	0.3018	0.1305	0.0047	-0.0402	0.3346
	G -0.0383	0.3368	-0.1375	-0.1451	0.5722	0.2051	1.0000	0.2387	-0.1997	-0.3136	0.2364	-0.2012	0.0089	0.3368	0.1671	0.0038	-0.0533	0.3882
8	P 0.1311	-0.3136	0.1978	0.2099	0.4477	0.3875	0.2571	1.0000	0.0556	-0.2586	0.1594	-0.2118	0.1171	0.3654	0.3697	-0.2856	0.1092	0.4405
	G 0.1574	-0.4399	0.2217	0.2503	0.5037	0.4400	0.2387	1.0000	0.0943	-0.2924	0.2090	-0.2266	0.1342	0.4089	0.4478	-0.3148	0.1172	0.5110
9	P 0.1458	-0.1355	0.8582	0.8469	-0.1943	-0.1432	-0.1739	0.0556	1.0000	0.2754	-0.0138	-0.0526	-0.0197	-0.2138	-0.1397	-0.3360	-0.2386	-0.1730
	G 0.1496	-0.1255	0.9183	0.9089	-0.2204	-0.1524	-0.1997	0.0943	1.0000	0.2917	-0.0104	-0.0580	-0.0119	-0.2113	-0.1495	-0.3465	-0.2577	-0.1689
10	P 0.2429	-0.1900	0.1442	0.1450	-0.4285	-0.0386	-0.2973	-0.2586	0.2754	1.0000	-0.2036	-0.0123	-0.1574	-0.1316	-0.1226	-0.0175	-0.1304	-0.2820
	G 0.2563	-0.2000	0.1533	0.1569	-0.4679	-0.0310	-0.3136	-0.2924	0.2917	1.0000	-0.2133	-0.0130	-0.1644	-0.1310	-0.1098	-0.0157	-0.1270	-0.2978
11	P -0.0052	-0.0708	0.2378	0.1925	0.0824	0.0727	0.1978	0.1594	-0.0138	-0.2036	1.0000	0.0595	0.6067	-0.0321	0.2097	0.1005	-0.0730	0.4159
	G -0.0276	-0.0801	0.2451	0.2118	0.0849	0.0663	0.2364	0.2090	-0.0104	-0.2133	1.0000	0.0111	0.6464	-0.0382	0.2479	0.1032	-0.0892	0.4574
12	P -0.3968	-0.1151	-0.1603	-0.1995	-0.2292	-0.3096	-0.1550	-0.2118	-0.0526	-0.0123	0.0595	1.0000	0.3974	-0.4166	-0.5422	0.4109	0.0564	-0.1202
	G -0.4555	-0.1396	-0.1807	-0.2086	-0.2663	-0.3519	-0.2012	-0.2266	-0.0580	-0.0130	0.0111	1.0000	0.4305	-0.4444	-0.6534	0.4422	0.0551	-0.1226
13	P -0.2435	-0.1297	0.1569	0.1114	-0.0012	-0.1300	-0.0058	0.1171	-0.0197	-0.1574	0.6067	0.3974	1.0000	-0.2890	0.0423	0.2083	0.0510	0.3863
	G -0.2605	-0.1574	0.1635	0.1120	0.0039	-0.1304	0.0089	0.1342	-0.0119	-0.1644	0.6464	0.4305	1.0000	-0.3070	0.0366	0.2128	0.0434	0.3918
14	P 0.0697	0.1220	-0.1012	-0.1295	0.3539	0.7870	0.3018	0.3654	-0.2138	-0.1316	-0.0321	-0.4166	-0.2890	1.0000	0.5027	-0.2207	-0.0144	0.1756
	G -0.0706	0.1218	-0.1025	-0.1413	0.3786	0.8217	0.3368	0.4089	-0.2113	-0.1310	-0.0382	-0.4444	-0.3070	1.0000	0.5700	-0.2369	-0.0072	0.7219

Table 3 continued..

Table 3 continued...

15	P	0.2244*	-0.0164	0.0928	0.1421	0.2728*	0.4886**	0.1305	0.3697**	-0.1397	-0.1226	0.2097*	-0.5422*	0.0423	0.5027*	1.0000	-0.2887**	0.0506	0.4446**
	G	0.2781**	-0.0004	0.0906	0.1279	0.3402*	0.5315**	0.1671	0.4478*	-0.1495	-0.1098	0.2479*	-0.6534**	0.0366	0.5700*	1.0000	-0.3228**	0.0709	0.5072**
16	P	-0.2775**	0.0166	-0.3573**	-0.3237**	-0.1002	-0.2753**	0.0047	-0.2856**	-0.3360**	-0.0175	0.1005	0.4109*	0.2083*	-0.2207	-0.2887**	1.0000	-0.1977*	-0.0492
	G	-0.2896**	0.0106	-0.3666**	-0.3327**	-0.1044	-0.2878**	0.0038	-0.3148**	-0.3465**	-0.0157	0.1032	0.4422*	0.2128*	-0.2369**	-0.3228**	1.0000	-0.2047*	-0.0565
17	P	-0.1045	0.0352	-0.2458*	-0.2233*	-0.0583	0.1275	-0.0402	0.1092	-0.2386**	-0.1304	-0.0730	0.564	0.0510	-0.0144	0.0506	-0.1977*	1.0000	-0.0759
	G	-0.1072	0.0505	-0.2613**	-0.2277**	-0.0571	0.1376	-0.0533	0.1172	-0.2577**	-0.1270	-0.0892	0.0551	0.0434	-0.0072	0.0709	-0.2047*	1.0000	-0.0745
18	P	-0.0855	0.0539	0.0621	0.0107	0.3492*	0.6221**	0.3346**	0.4405**	-0.1730	-0.2820**	0.4159**	-0.1202	0.3863**	0.7156**	0.4446**	-0.0492	-0.0759	1.0000
	G	-0.0941	0.0426	0.0680	0.0076	0.3753**	0.6578**	0.3882**	0.5110**	-0.1689	-0.2978*	0.4574**	-0.1226	0.3918**	0.7219*	0.5072**	-0.0565	-0.0745	1.0000

*and ** significance at 5% and 1% levels, respectively.

Rajendranagar, Hyderabad (A.P.), India. These entries comprised the local genotypes collected from different parts of Arunachal Pradesh. Each genotype was accommodated in a row of 6 m length with 90 cm line-line and plant-plant spacing of 60 cm. Fertilizers as 50 kg N, 60 kg P₂O₅ and 40 kg K₂O were applied to raise good stand. The data were recorded on five randomly selected plants in each plot for 18 quantitative traits, *viz.*, plant height (cm), number of primary branches, days to first flowering, days to 50% flowering, length of inflorescence (cm), number of inflorescence per plant, number of flowers per inflorescence, number of pods per inflorescence, days to first pod harvest, days to last pod harvest, pod length (cm), pod width (cm), pod weight (g), number of pods per plant, number of seeds per pod, 100 seed weight (g), protein content (%) and marketable pod yield per plant. Data on twelve qualitative characters was recorded on stem pigmentation, pod colour, pod beak shape, pod pubescence, pod shape, pod curvature, parchment layer, seed colour, seed mottling, brilliance of seed and seed shape as per the minimal descriptors of NBPGR (National Bureau of Plant Genetic Resources). Correlation coefficient was worked out as per Al Jibouri *et al.* (1958) and path coefficient for various characters was calculated by formula given by Dewey and Lu (1959).

Results and Discussion

There was a considerable variation among the forty four French bean genotypes for twelve qualitative characters studied. The details of which are presented in table 1. Maximum number of genotypes possessed green pigmented stem, white flower wing and flat dark green slightly curved short beaked pods with intermediate pubescence. Seeds of which had shiny cream coloured kidney shape without mottling indicating wider diversity in phenotypic characters among the genotypes studied.

Correlation coefficient analysis revealed that genotypic correlations were found to be higher than the corresponding phenotypic correlation coefficients for all the characters indicating the supervision of phenotypic expression under the influence of environmental factors (table 2). Marketable pod yield per plant was found highly and significantly positively correlated at both genotypic and phenotypic levels with length of inflorescence, number of inflorescence per plant, number of flowers per inflorescence and number of pods per inflorescence. This vividly suggests that simultaneous selection for these traits would be effective in improving total green pod yield per plant. Similar results have been reported by Patil *et al.* (2004), Siroshi (2005), Nahar and Newaz (2005), Chauhan *et al.* (2007) and Bangar *et al.* (2008).

Days to first flowering, days to 50% flowering, days to first pod harvest, days to last pod harvest, pod length, pod width, pod weight, number of seeds per pod, number of pods per plant had significant positive association with marketable pod yield per plant. Hence, direct based on these traits will be rewarding to a breeder. These results are in accordance with the findings of Mishra *et al.* (2008), Rai *et al.* (2008) and Guleria *et al.* (2009). On contrary, marketable pod yield per plant exhibited significant negative correlation with days to last pod harvest.

Path coefficient analysis revealed that number of pods per plant exhibited high positive direct effect on marketable pod yield per plant followed by pod weight at both levels of significance (table 3). The present results are in line with those obtained by Mishra *et al.* (2008), Rai *et al.* (2008), Rai *et al.* (2009), Chattopadhyay and Dutta (2010).

Days to 50% flowering exhibited low positive direct effect at phenotypic level and high positive direct effect on marketable pod yield per plant at genotypic level, respectively. Number of pods per plant also showed high positive indirect effect through number of inflorescences per plant, number of seeds per pod, number of pods per inflorescence and length of inflorescence, moderate positive indirect effect through number of flowers per inflorescence and low positive indirect effects through number of primary branches per plant. Pod weight also exhibited high positive indirect effect through pod length and pod width and low positive indirect effect through 100 seed weight and days to first flowering on marketable pod yield. This suggested that indirect selection based on number of inflorescences per plant will be effective in yield improvement.

From the foregoing investigation, it can be concluded that number of pods per plant and pod weight are considered to be vital traits in selection of desirable genotypes of French bean.

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